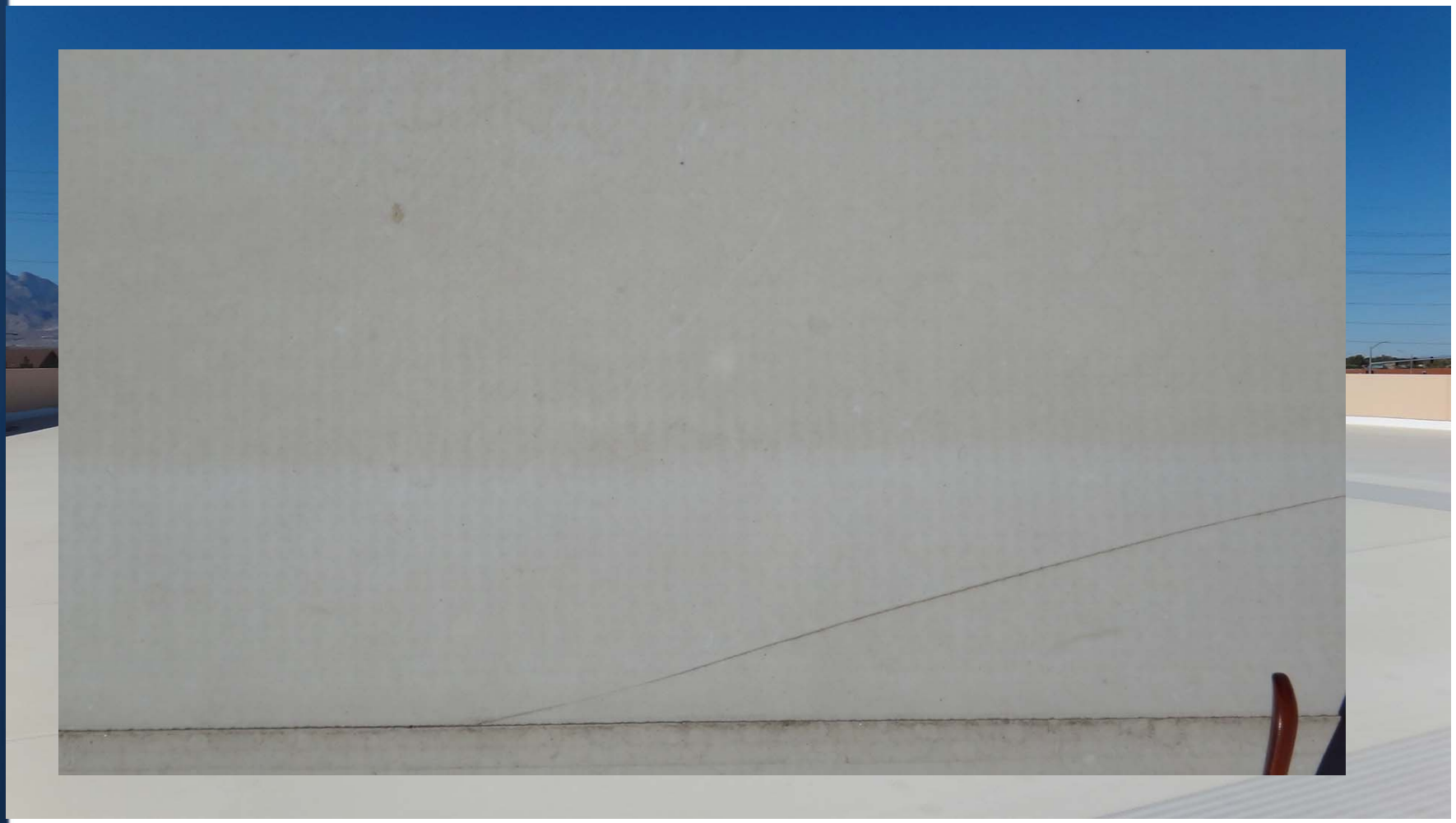
Over 20 yrs of Proven Performance

1 Billion sq.ft installed every year.

~25,000 miles of welds – that's once around the Earth!!

13yr old EverGuard 45 mil in Las Vegas

Closer Look Confirms It’s In Good Shape



Industry Studies with questionable data presentation:

- Many claim they're the best but data shown might be "cherry picked"
- One competitor's sell sheet shows samples failing at different durations (Testing at 275F)
- There is a competitor's study that is incomplete… only showing results of certain samples for certain tests; not every sample in every test
- There is a study showing quantity of ingredients in their membrane, without showing if/how it affects membrane performance
  - Claiming more total ingredients is better; and ignoring ingredient quality
- Some studies make blanket claims of superiority without showing actual test data
- One study suggests that cracking in heat aged samples shouldn't be the only mode of failure to look for; weight loss should also be monitored.

Take away = all studies need to be reviewed with a critical eye for inconsistencies and validity.

GAF

Perceived Bias…

Internal testing

Used old competitive material

Didn’t present performance data

There’s NO Independent 3rd Party Testing!

Didn’t always show all samples

Cherry picked your own material

Not using the right measurement

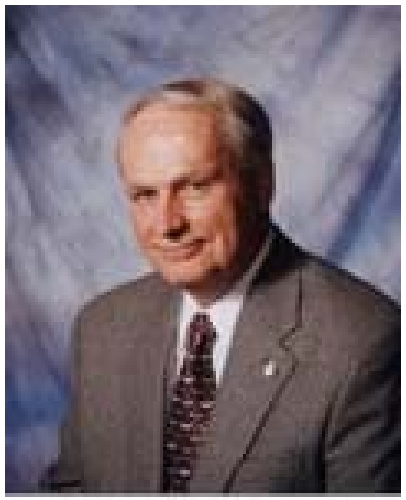
Ideal Study

√	Recent product • Produced in similar time frame
√	Produced in all plants
√	Multiple rolls
√	Different days production
√	All manufacturers
√	Testing by reputable firm

Until Now…

Plan	Collect	Test
In 2013, GAF hired SRI	SRI obtained material independently	GAF, Firestone, Carlisle, & JM were all tested • 5 rolls from each TPO plant • Product was made at various times throughout 2013 • Tested over 165 samples • <u>All 60 mil product</u>

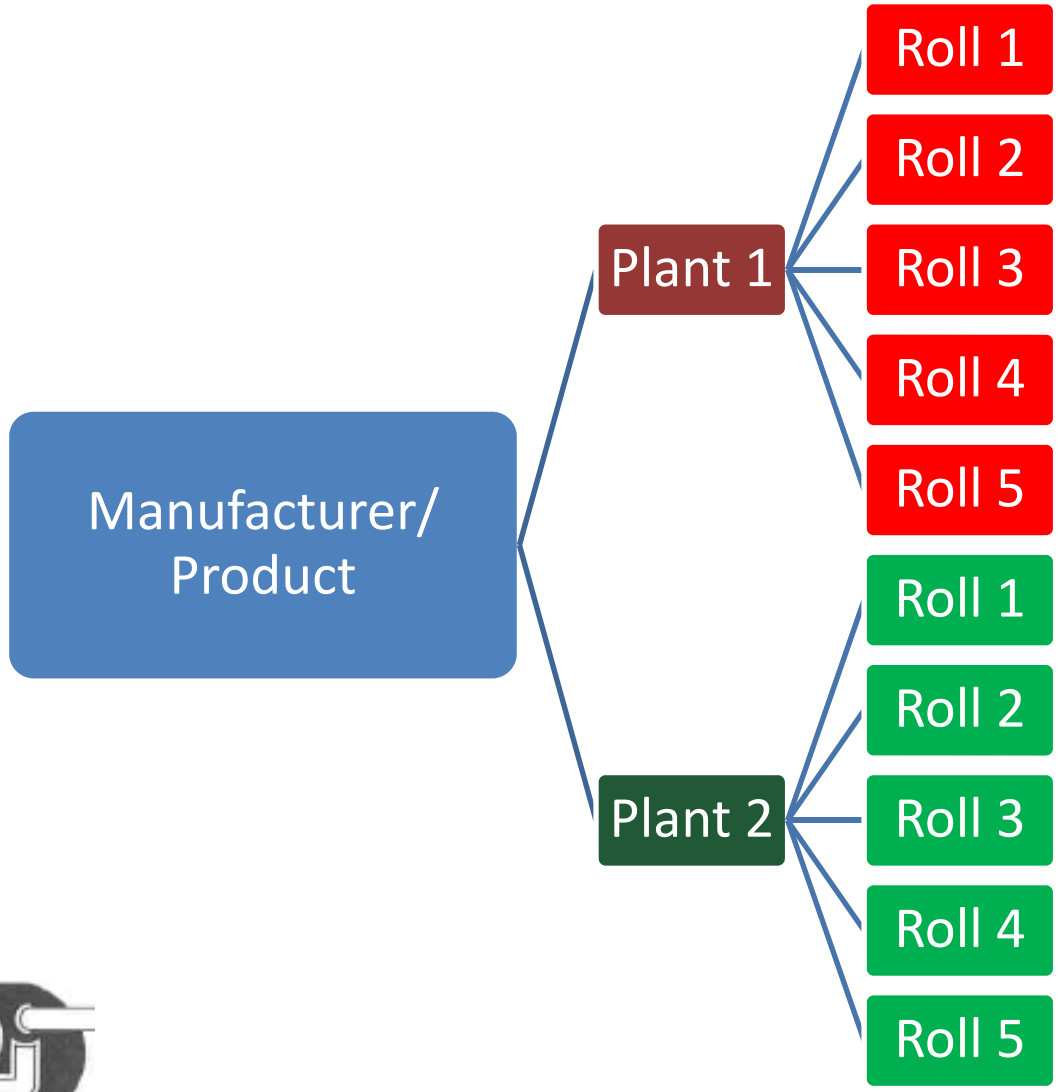
About SRI



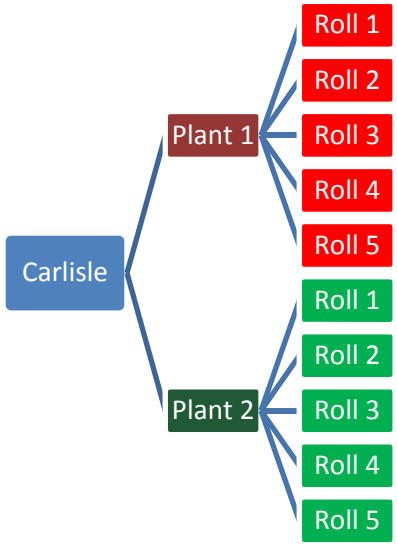
Led by Rene Dupuis

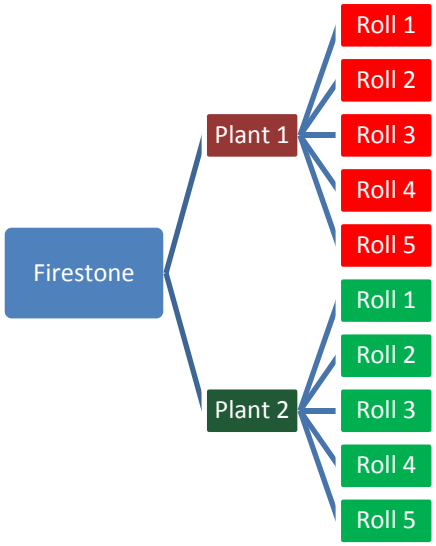
- Highly respected; recognized as very independent
- Very active in the MRCA and NRCA
- Sits on several ASTM roofing committees
- Material testing of roofing products for building owners, industry associations, and other consultants.
- Factory Mutual Contractor Approval Standard TF Committee
- Has served as an NRCA Gold Circle Award judge since 1997.
- SRI is recognized as being among the nation's leading structural engineering experts

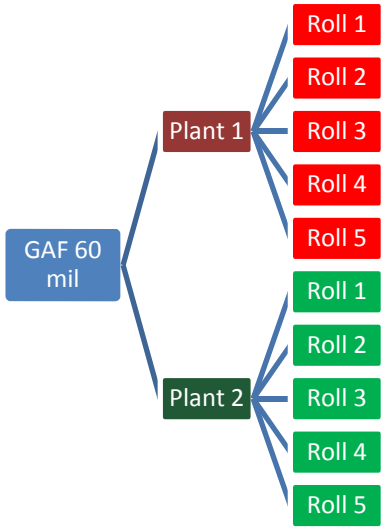
Extensive Sampling

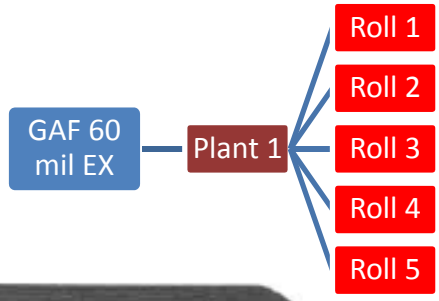


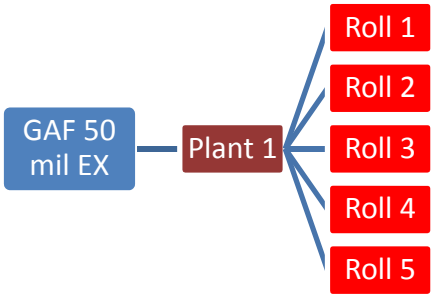
What We're Talking About... In Context

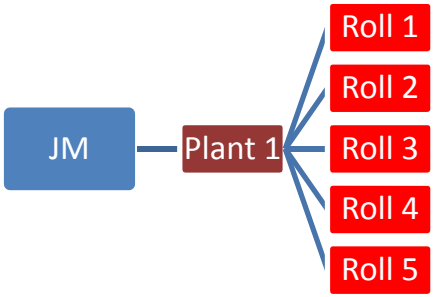












Extensive Testing Included…

Thickness Measurement

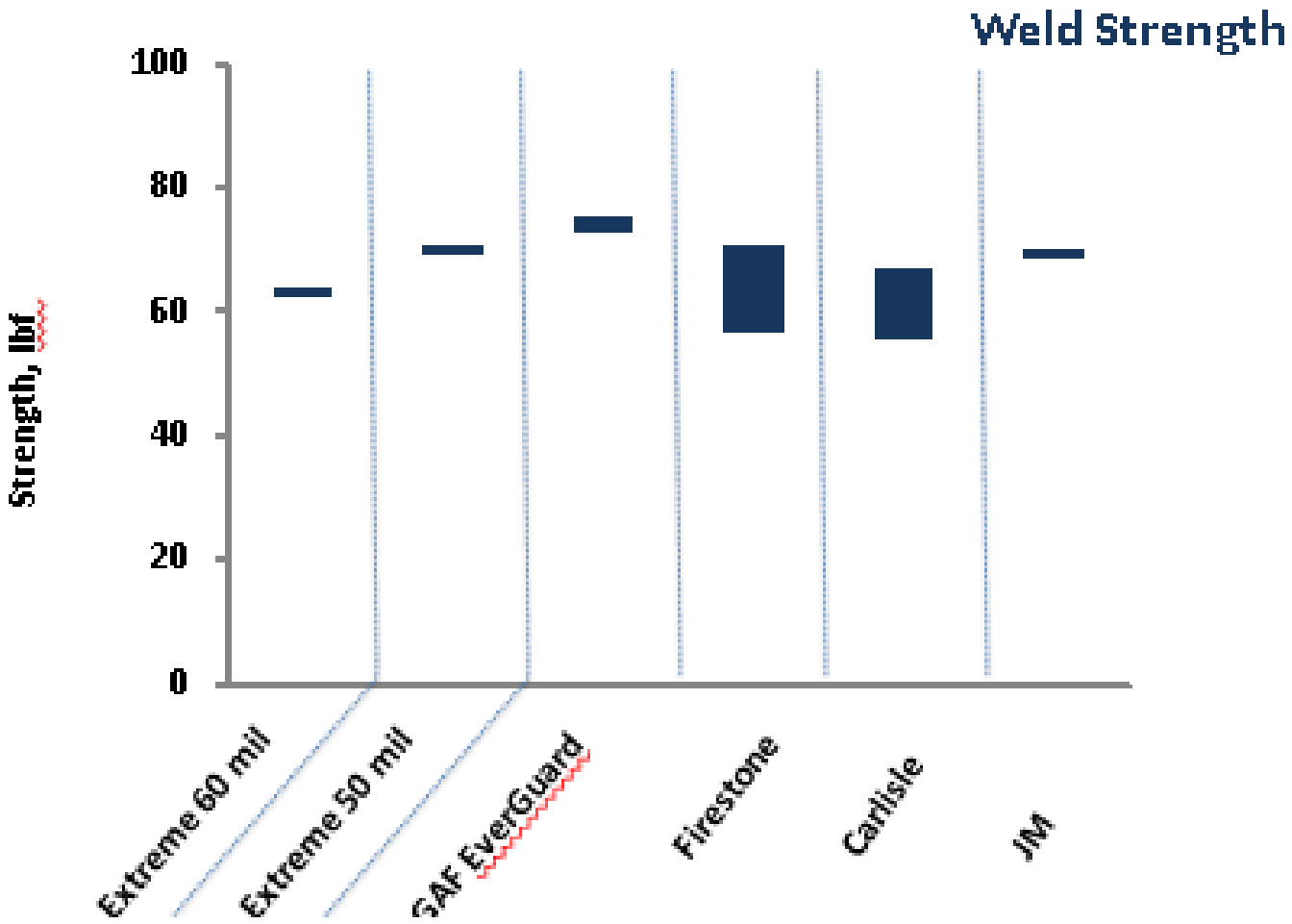
Weld Strength

Over 400 samples tested and over 6,000 measurements were taken

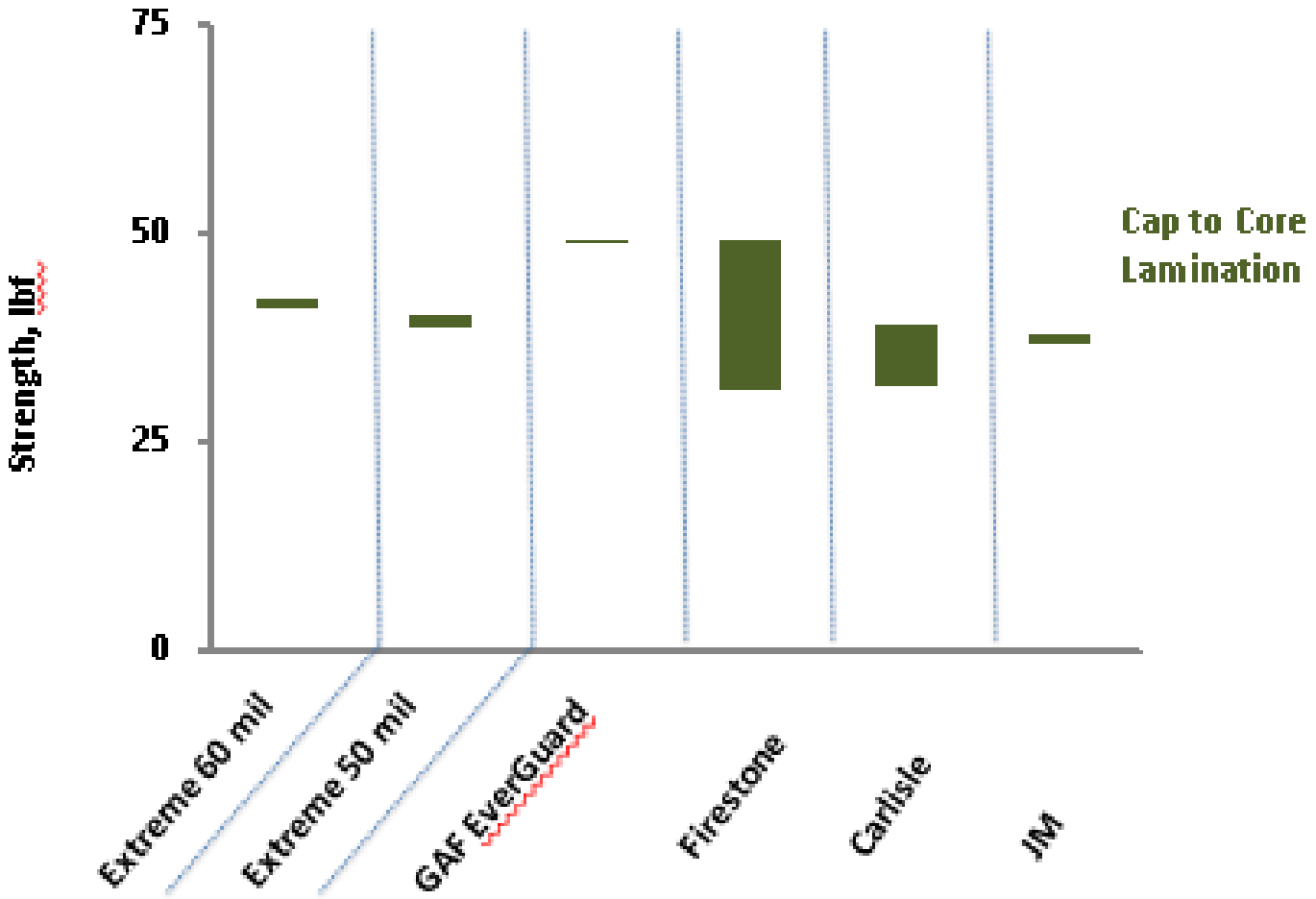
Cracking

Erosion

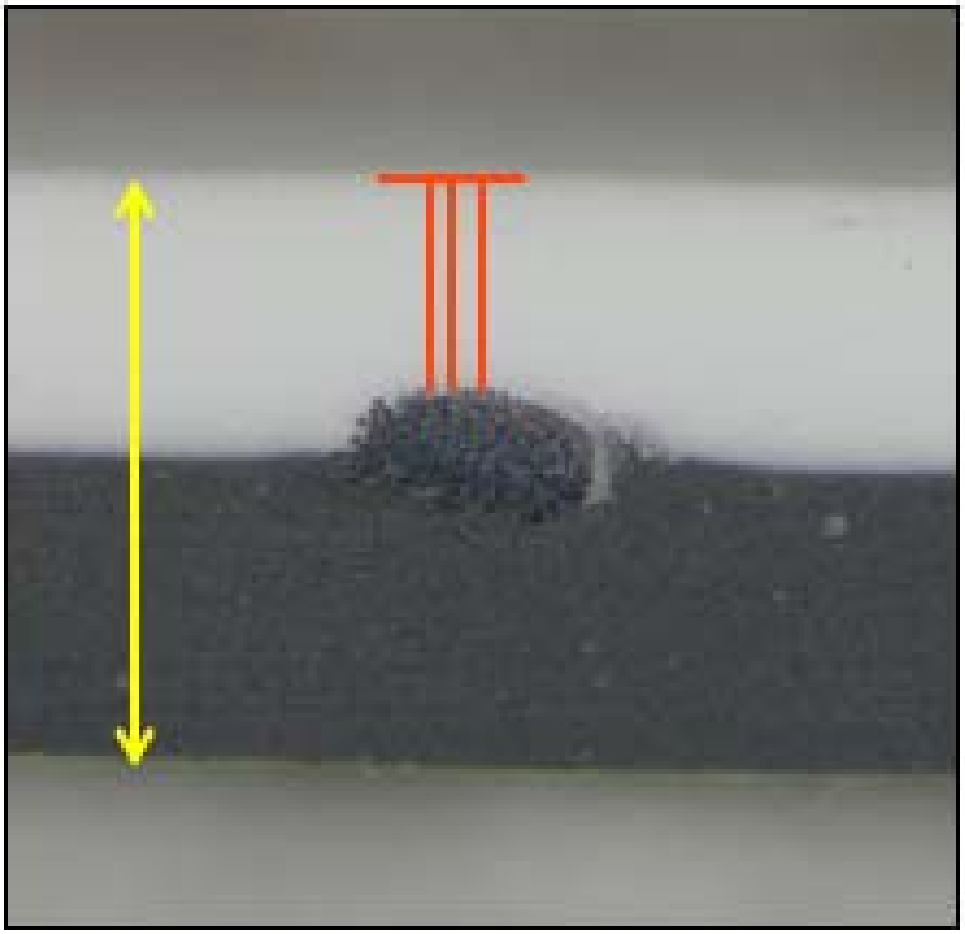
Not a Big Difference in Physical Properties…



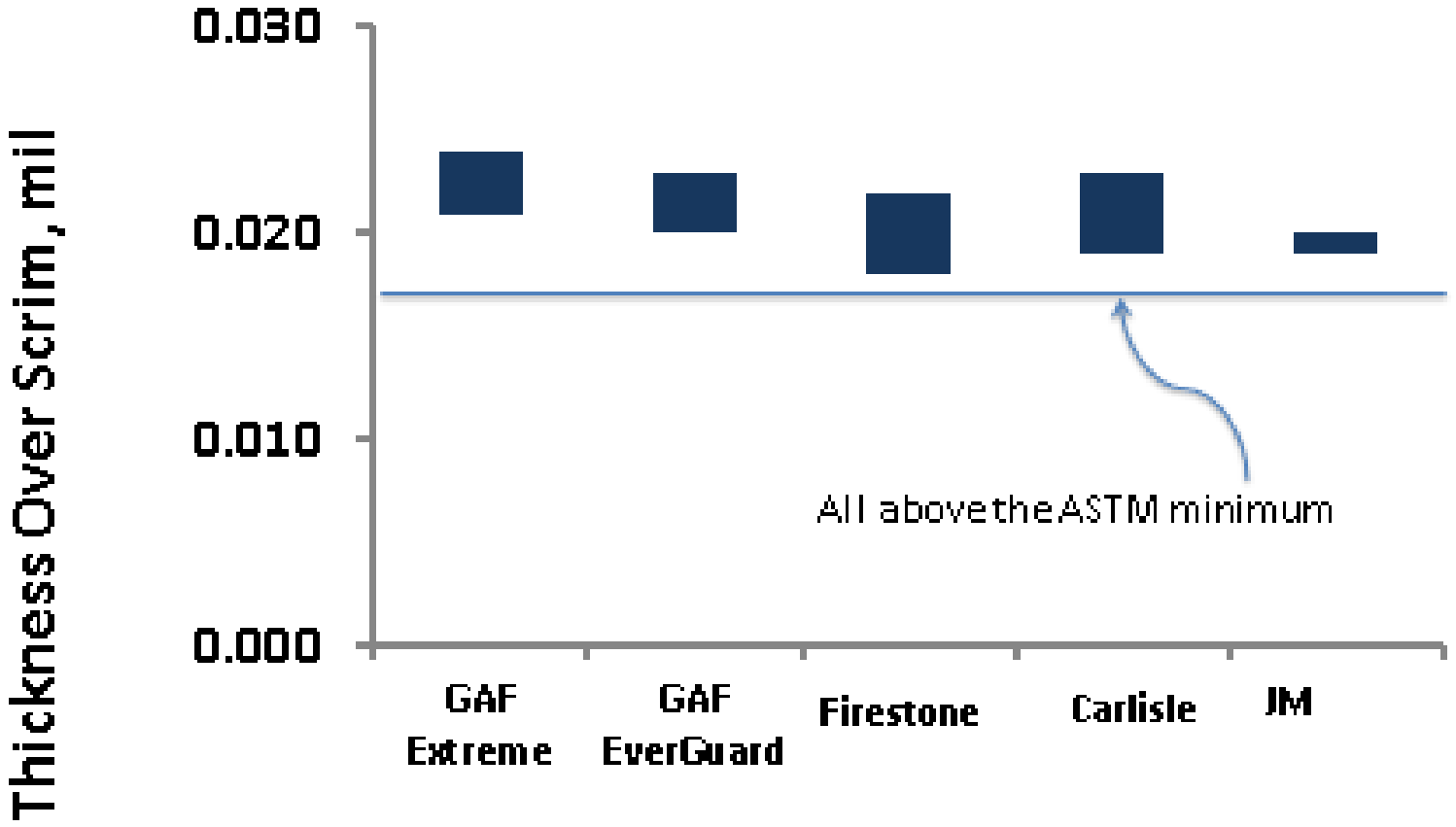
Not a Big Difference in Physical Properties…



Thickness Above Scrim



60 mil Thickness Above Scrim



ASTM min= 18 mils on 60 mil

Thickness – Total

- Everyone's the same!

Thickness over scrim

- No clear winner; differences are very small!

Extreme Heat Aging 275°F

- Samples were removed periodically and measured
  - Samples were bent over a 3” mandrel
  - 7x eyepiece was used to see if there was a failure
- 3 samples from each sheet were tested
  - All samples were taken from 30”, 60”, and 90” across sheet
- Same samples were tested each time…some samples were bent over 22 times before failure

It's About Performance!

- Heat aging **isn't** just about high heat situations
- Xenon Arc **isn't** just about areas that get high levels of UV
- **Accelerated Aging is Established Science!**

You Want Your Roof to Perform

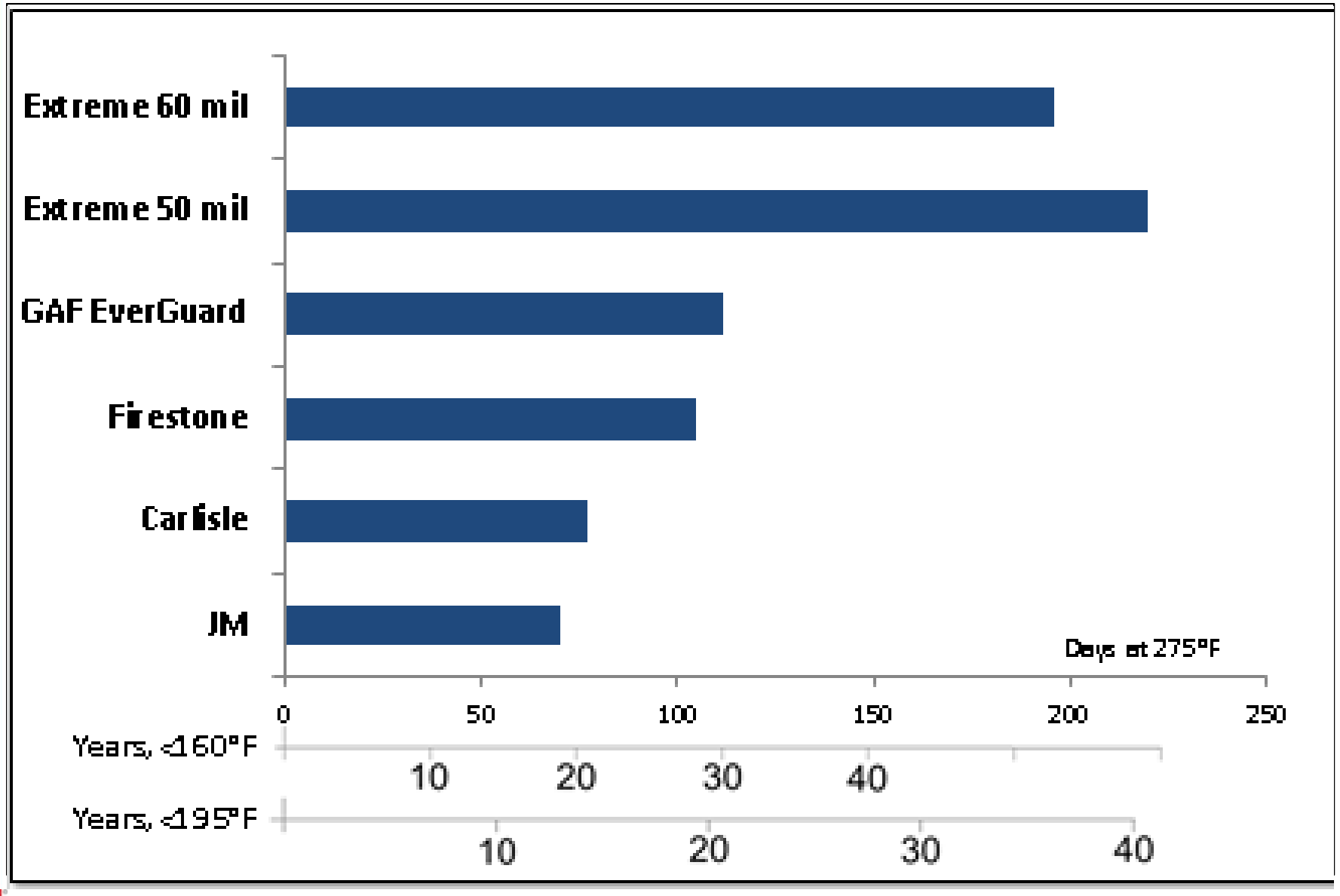
- **So, lets look at the data…**
- **How do we define membrane failure?**
  - **When it cracks!**

What Cracking Means…

Test Sample

Real World

Time Before Failure Begins (Cracking)



Note: Actual roof life will depend on operating conditions, method of attachment, maintenance, and other factors.

NEW Learning From Study

SRI brought to the table…

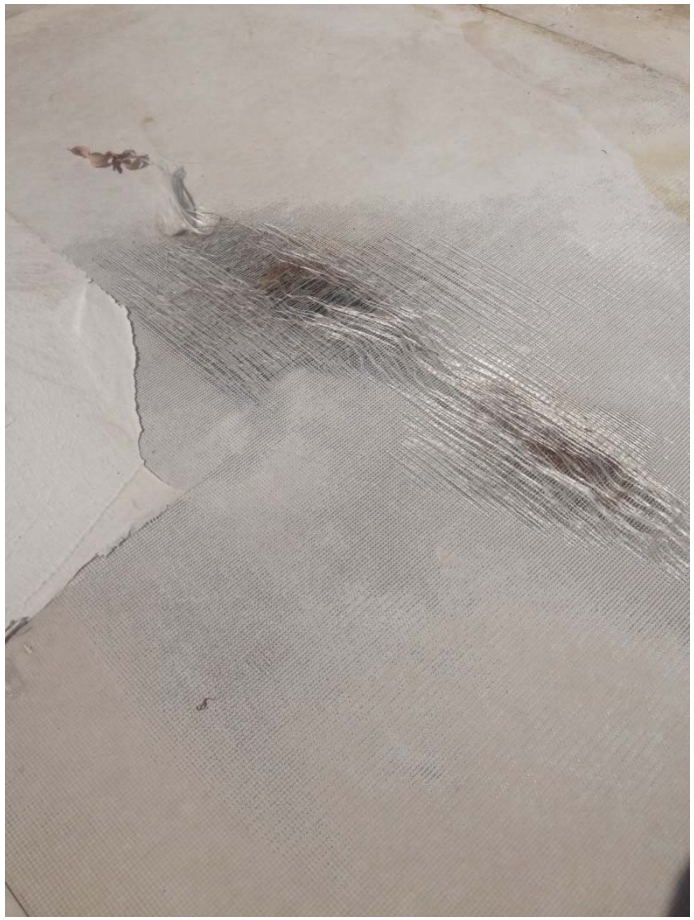
- Weight Loss
- It's not just about cracking
- JM has been an advocate of using weight loss

Why Test?	**As products weather they lose polymer**
What does it mean?	**TPO loses weight when it's not formulated correctly**
How to talk about it?	**The more weight you lose, the less material you have to protect your roof**

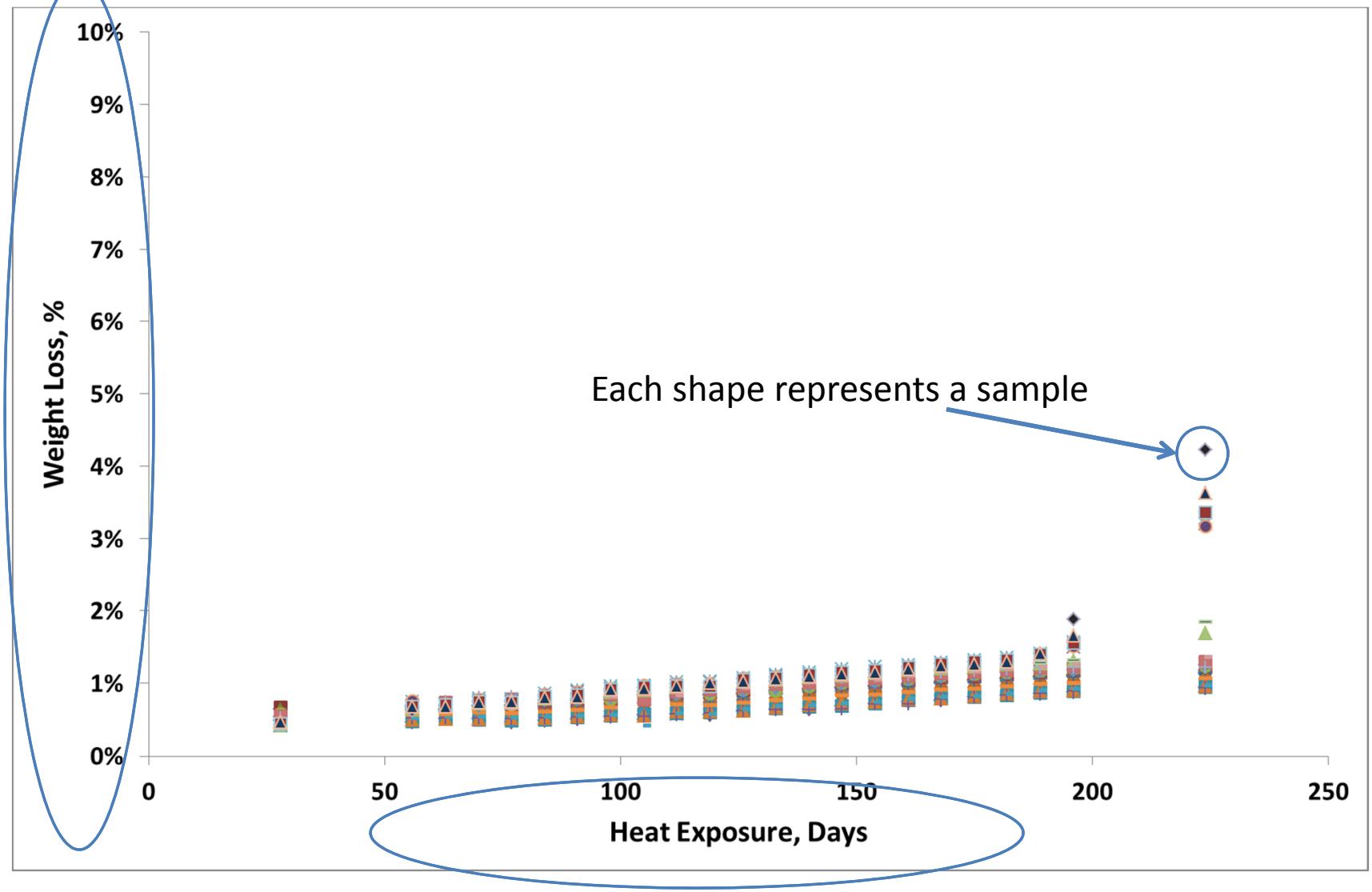
Competitive learning of eroding membrane


Someone's been doing repairs…
10/11/2013 13:40
Let's get closer to this….

Weight Loss Can Lead To…

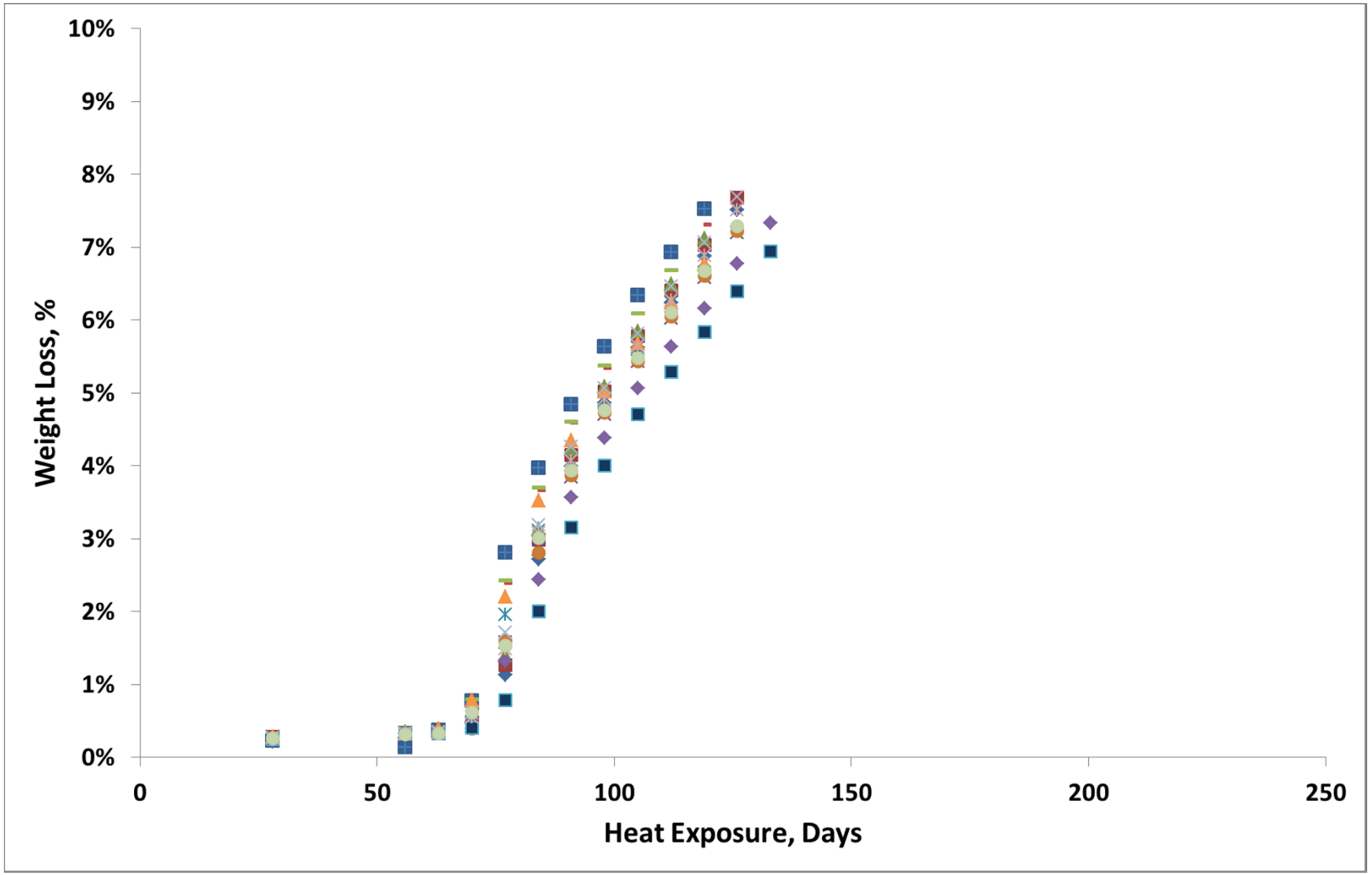


An Extremely How A Good Membrane Should Perform



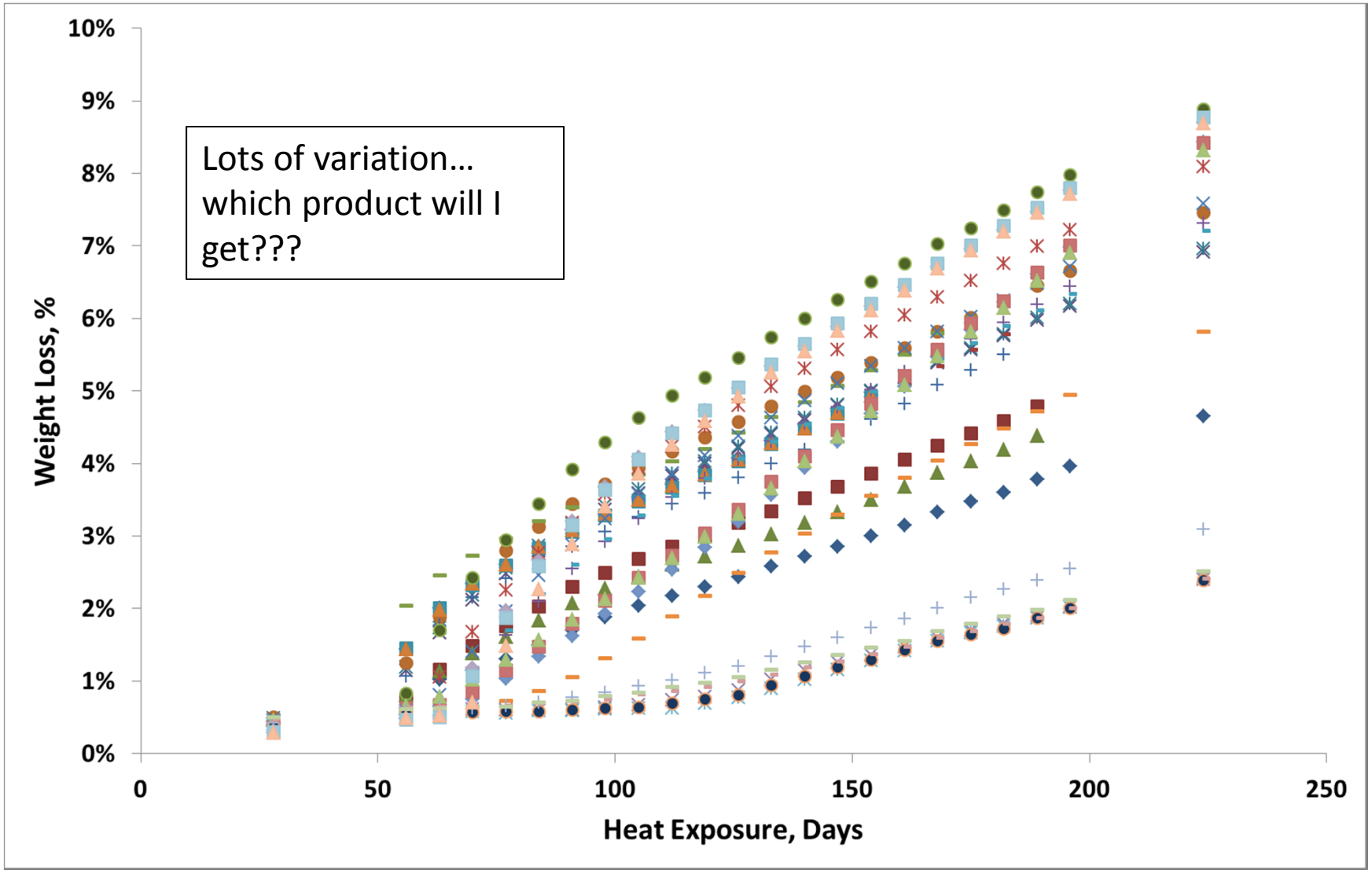
15 samples

Same Failure Just Not Very Good

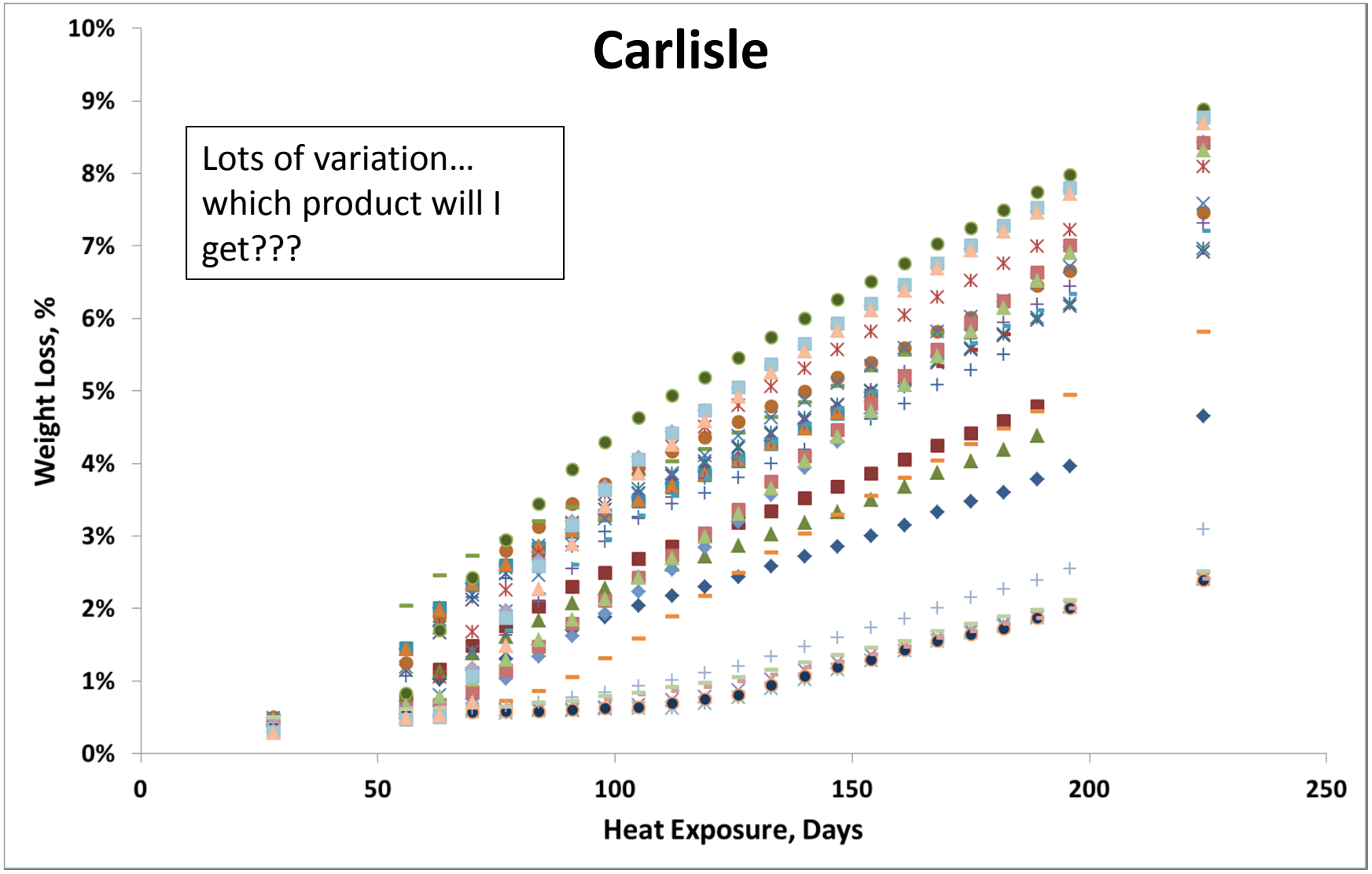


15 samples

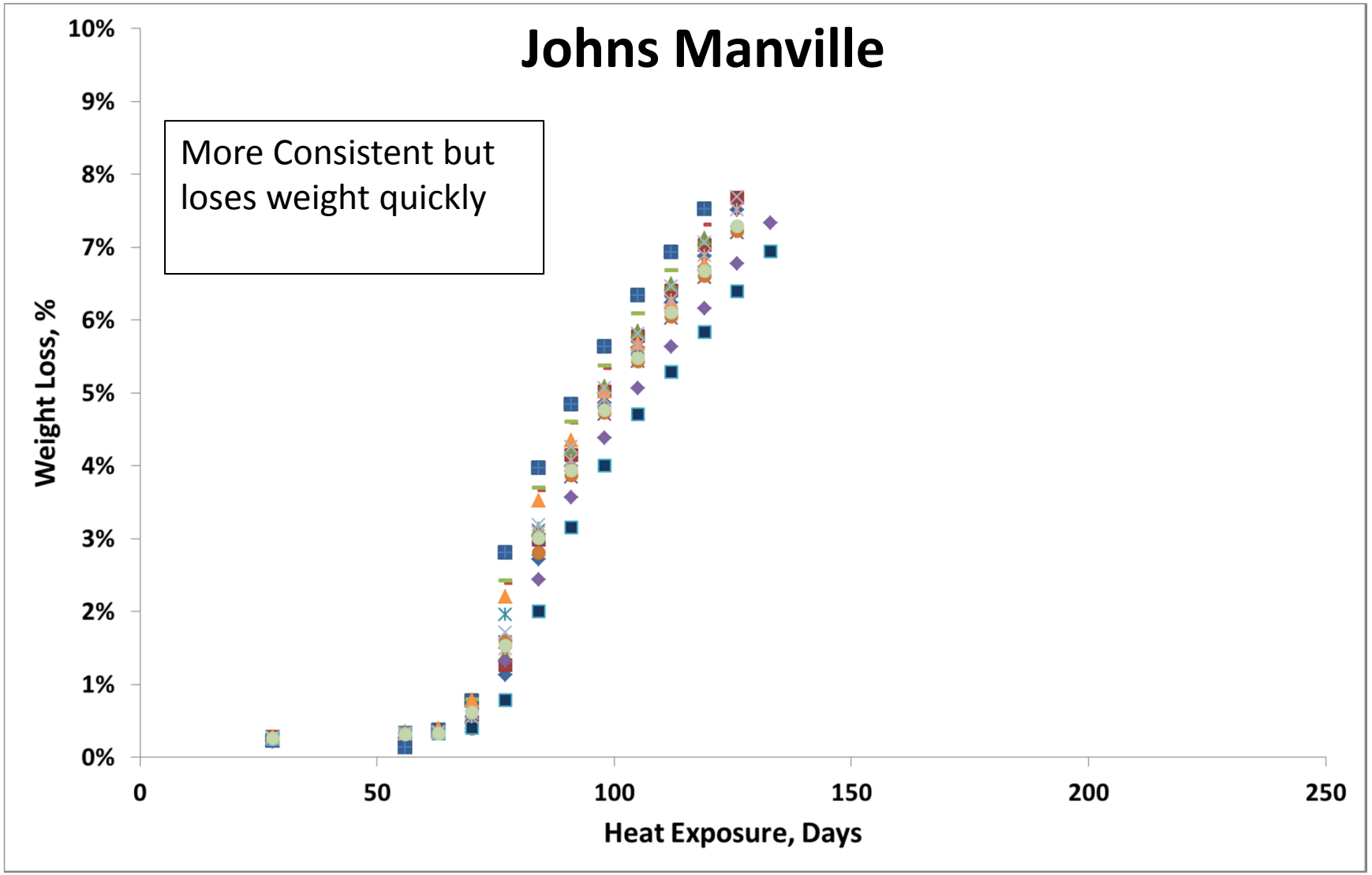
Inconsistent



30 samples

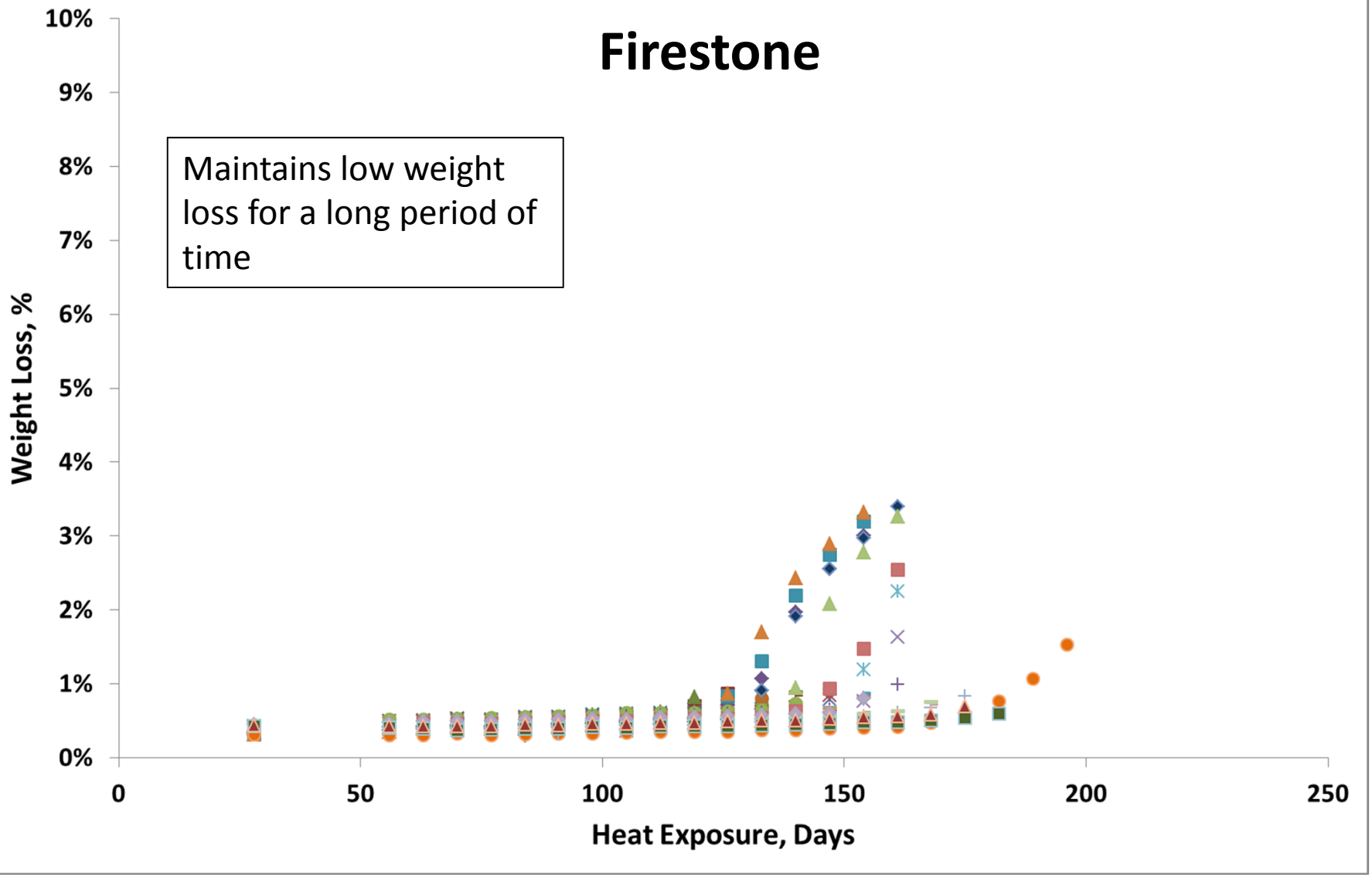

Carlisle
Lots of variation… which product will I get???
Weight Loss, %
10%
9%
8%
7%
6%
5%
4%
3%
2%
1%
0%
0
50
100
150
200
250
Heat Exposure, Days

30 samples


Johns Manville
More Consistent but loses weight quickly
Weight Loss, %
10%
9%
8%
7%
6%
5%
4%
3%
2%
1%
0%
0
50
100
150
200
250
Heat Exposure, Days

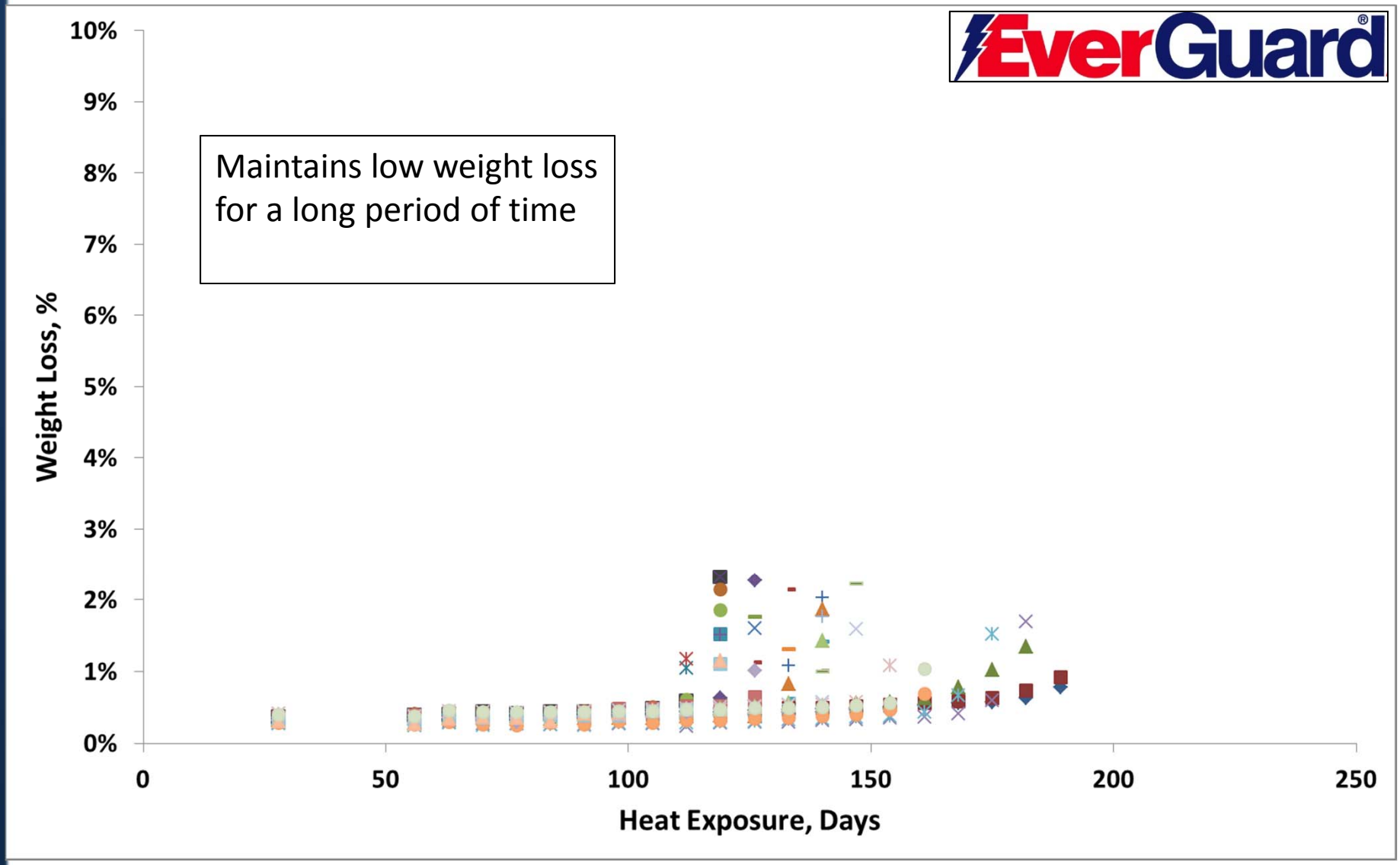
15 samples

Firestone



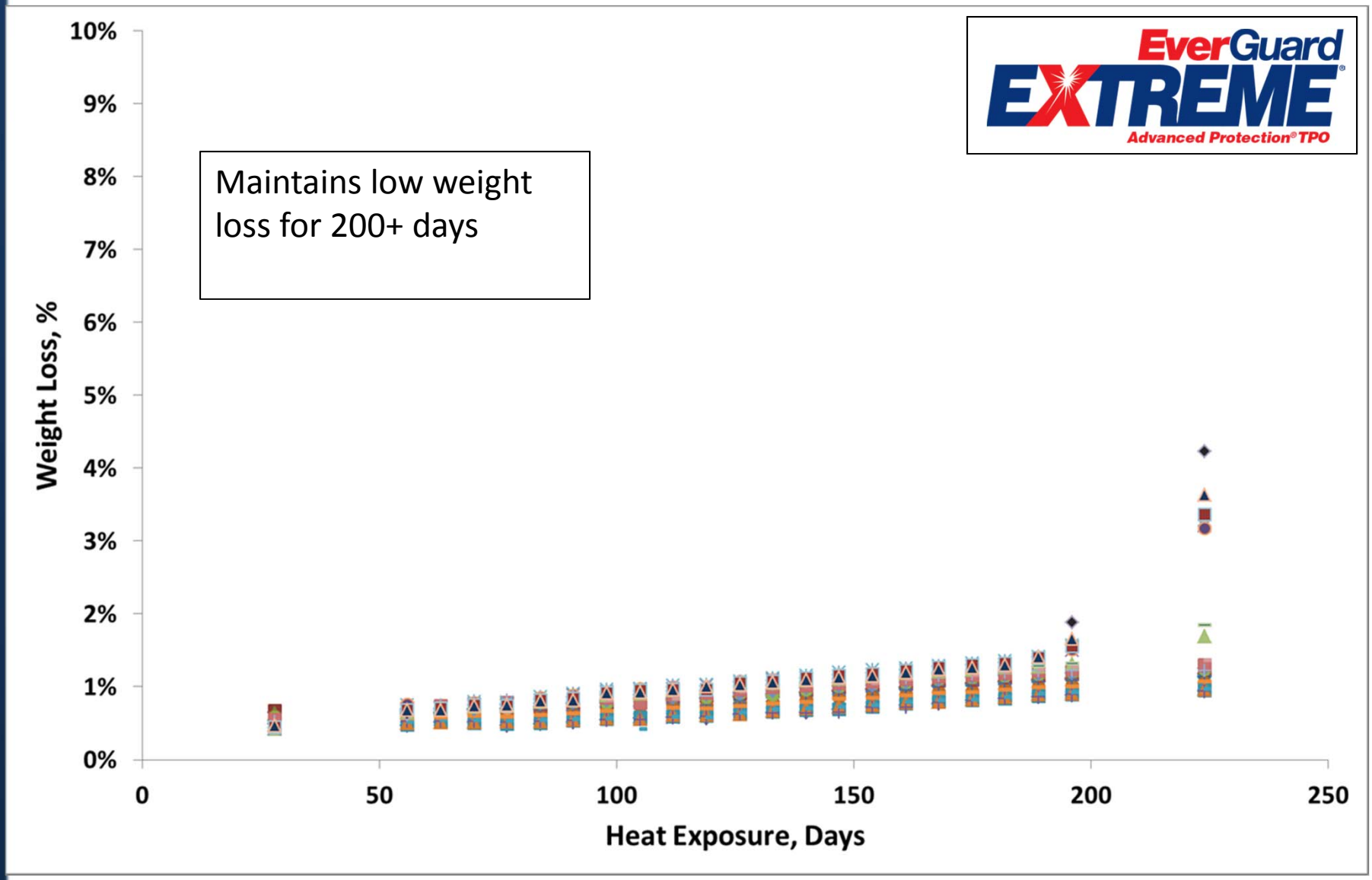
30 samples

GAF EverGuard 60 mil



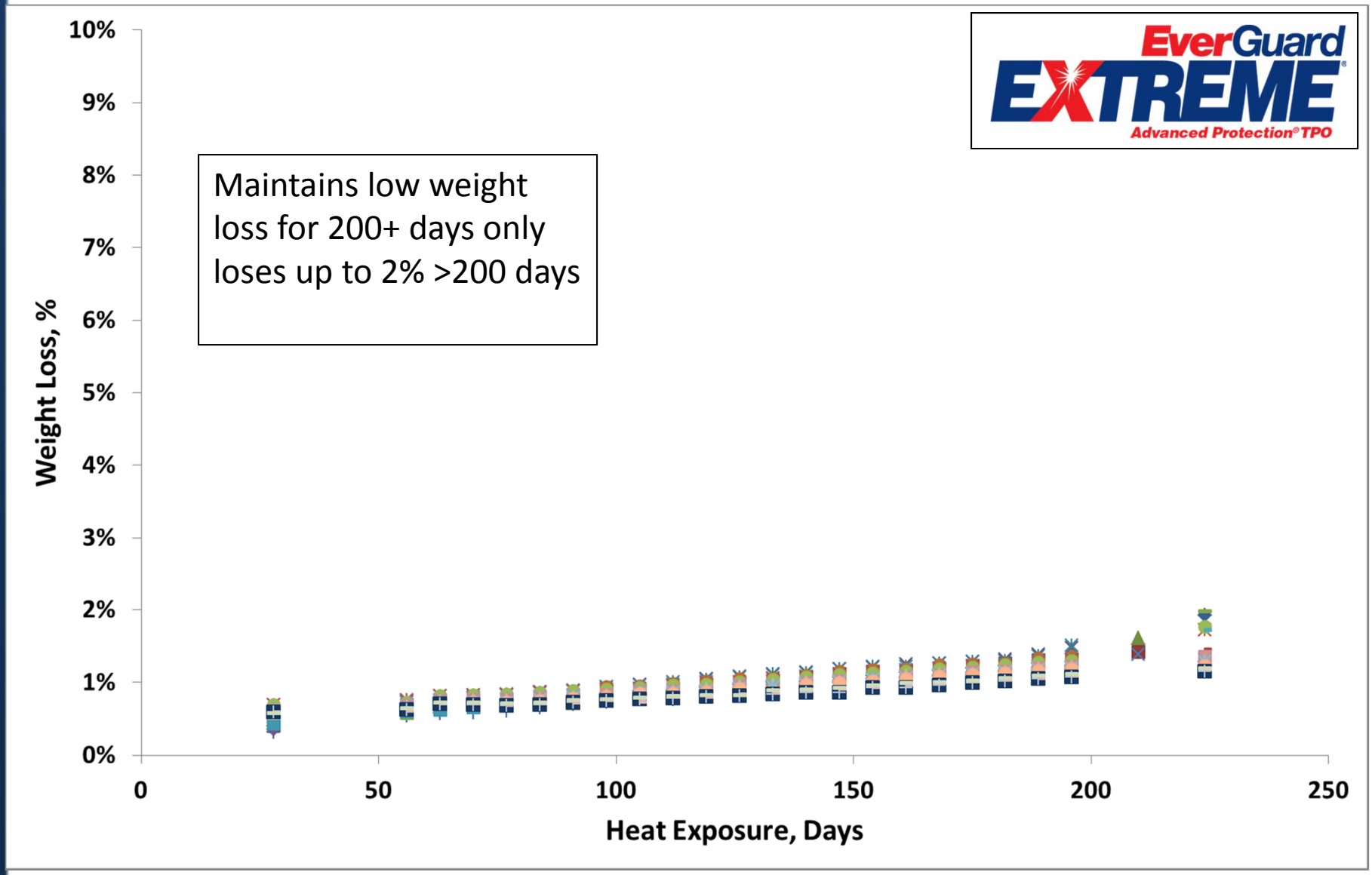
30 samples

GAF Extreme 50 mil



15 samples

GAF Extreme 60 mil



15 samples

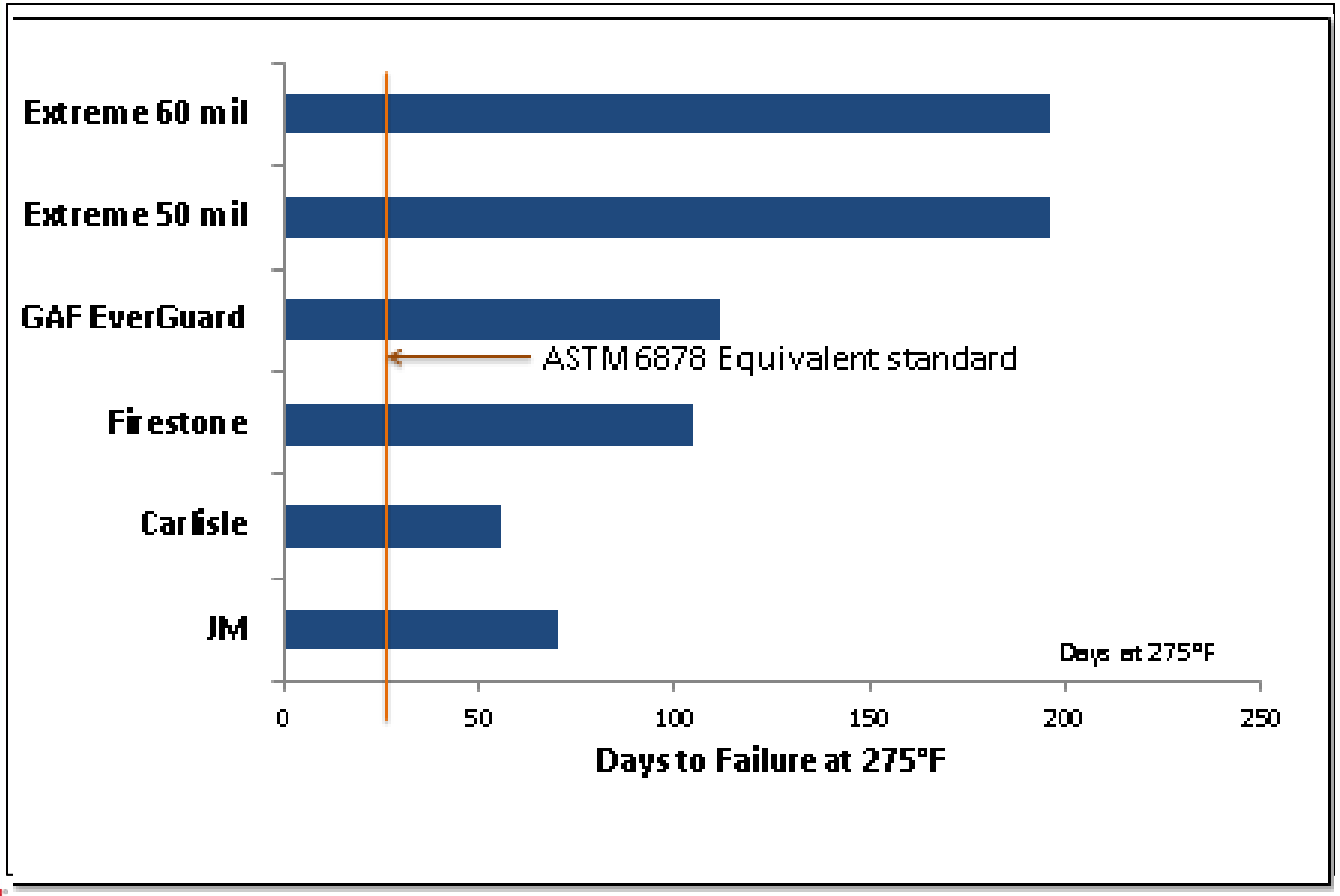
2 failure modes…

Cracking and Weight Loss

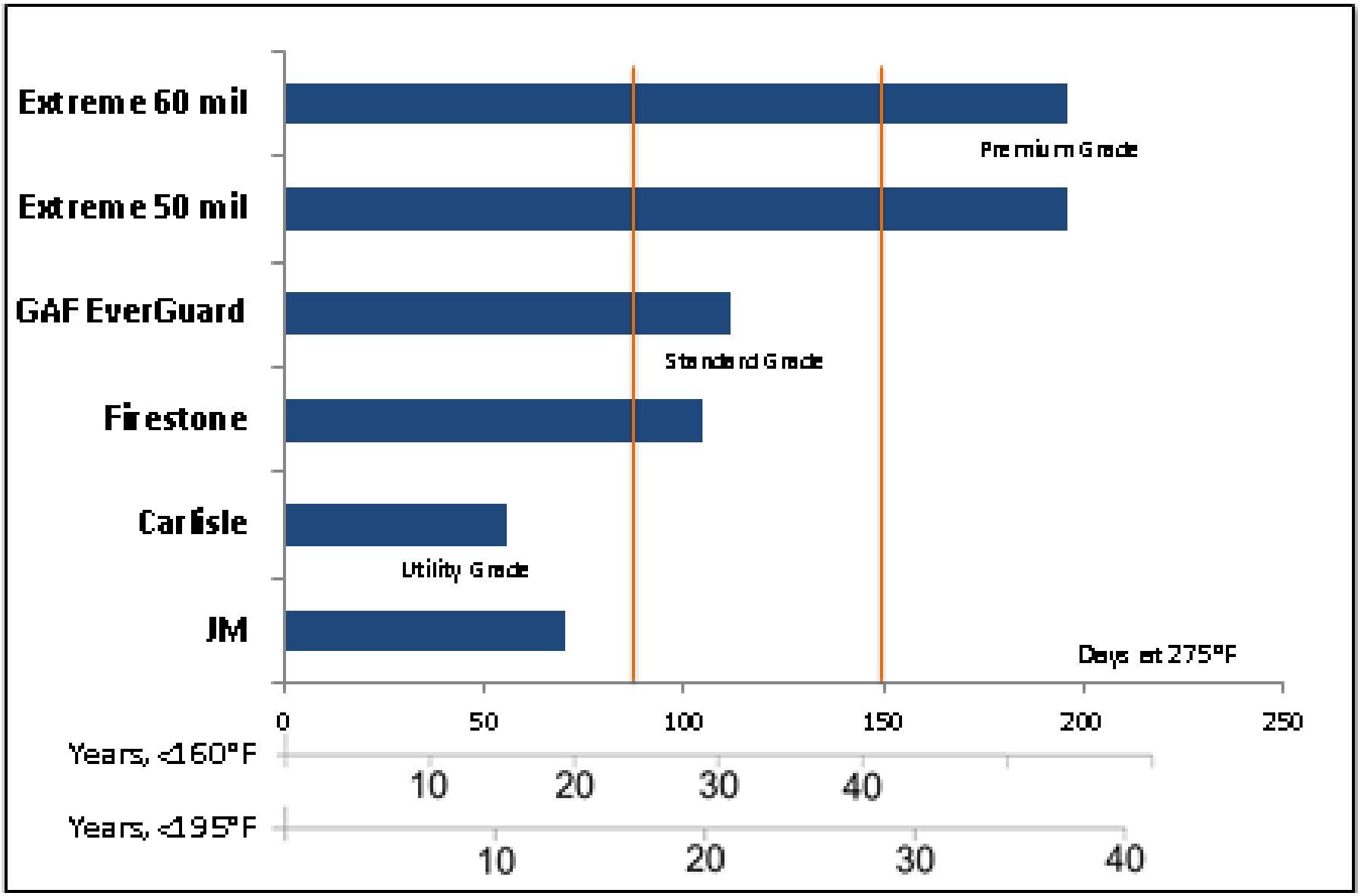
Doesn’t matter which happens first

Lets look at the weakest link…

Time Before Failure Begins (>1.5% wt. loss OR cracking)



Time Before Failure Begins (>1.5% wt. loss OR cracking)



Note: Actual roof life will depend on operating conditions, method of attachment, maintenance, and other factors.

Categorizing & Specifying

TPO Grade	Heat Aging, days to failure		Weather Resistance kJ/(m^2.nm) @ 340 nm
	240°F	275°F	
1 – utility grade	224	27	10,080
2 – standard grade	490	90	20,160
3 – premium grade	750	150	40,320

Failure= cracking using 7x eye piece or weight loss > 1.5%

Conclusions

- All TPO exceeds the ASTM specification
- Physical properties are all similar
- Large differences exist in terms of predicted weathering
- GAF has the 3 best TPOs
- Extreme is the ONLY high performance TPO
- EverGuard outperforms all other regular TPOs